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RESEARCH IN INDUSTRY

WE were privileged to attend the recent conference convened by the Federation of British Industries upon the general subject of industry and research. It was convened to bring home to British industry the need for the scientific approach to the development of business, and in particular the need for setting up research laboratories or for supporting the research associations of those industries which possess them. That the conference was attended by no fewer than 1,400 delegates from all parts of the country is a sign of the change in outlook towards research and science which has taken place during the last two or three decades. It was perhaps symbolic of our times that the five speakers who addressed the meeting on the first morning were all men of great eminence, Knights of the Realm, well known for their active interest in the application of science to industry, a reason for which it is safe to say all of them had been knighted.

The Gas Industry was represented at that conference, although it might be suggested that gas as an industry is fully awake to the needs for research. There emerged from the discussions of the conference some broad principles, many of them not new, but all of them worth restating authoritatively with the full weight of the Federation of British Industries behind them. We have said that many might suppose that the Gas Industry is fully alive to research, but whether this is wholly true is open to some doubt. It may be that gas engineers generally would be fully research-minded if they could only understand the reports provided for them by the scientists. We hasten to add that the Director of Research is performing a most valuable service by explaining research reports to the District Gas Associations. There is indeed little excuse for any gas engineer who is not fully aware of the scientific work that is going on around him and of its implications and applications to his own daily work. Nevertheless, it is well that broad principles should be re-stated, and we propose to indicate very briefly some of these principles as outlined at the F.B.I. Conference.

The Gas Industry is the servant of all industries. Heat and power are peculiarly important in almost every industry, and upon the cost and efficiency of these services may well depend the efficiency of the whole industry, even when fuel and power are not the principal costs of the industry concerned. The gas and electrical industries between them thus occupy key positions throughout the whole of British industry.

NEED FOR CREATIVENESS

BRITISH industry in general has certain needs. There is the overriding need for exports, of which we are all painfully aware. A very important corollary is that we cannot have exports unless we increase the efficiency of our industrial production and of the utilization of our man-power. The debate in the House of Commons on April 8 contained a remarkable statement of the effect of fuel utilization on man-power. Mr. Errol, advocating the increased use of oil fuel, pointed out that in a particular plant of six Lancashire boilers the weekly cost of running with coal was £780, whereas that of oil firing was £920, but he added, "The main thing is that a saving of men amounting to no less than 13 is achieved by using oil instead of stoking solid fuel into the boilers." This is typical not only of the use of oil in industry, but to an almost greater extent of the use of gas in industry. Productivity per man-hour worked can be substantially increased, as indeed it must be if we are to retain our export markets, by the use of refined fuels. It is quite easy to secure export markets to-day. The whole world is crying out for goods. But in a very few years' time we shall find that the initial demand is satisfied, and customers will then look more keenly at price and quality than they do to-day. That is when the test will come. If we have not increased the efficiency of industry within that time we shall be in a bad way.

The third need to which attention should be called is that for greater creativeness in industry. One effect of the war has been that all nations have become to a greater or less extent industrialized. The first types of goods produced upon industrialization of a "backward" country are naturally the well-established manufactures with which British industrial prosperity was built up. Consequently, unless we have some much cheaper or more effective methods of producing these goods than the rest of the world—a most unlikely contingency—we cannot maintain our export trade by staple products, but only by new products. Britain must no longer be content to deliver the goods but must create new goods, and this demands both research and inventiveness. It demands also a willingness to take a chance in developing new products hot from the research laboratory. This spirit is to be found in some industries; only this week we heard of a great chemical concern which intends to build a new and untried plant costing something of the order of half a million pounds sterling; yet so little is known about the process that while the major plant is being built the research staff is operating a pilot plant in an endeavour to discover possible snags.

ENCOURAGEMENT

THE means for supplying these needs are not unknown. A great deal of knowledge is already possessed by mankind which can be put to good effect. Much of what is already known has never been used. Simultaneously we must extend the boundaries of knowledge, and that is a matter both for fundamental research and for industrial research. There must be close contact between industry and the universities. Far more of the best brains must be encouraged to enter industry. The recent reference made by Colonel Croft to the activities of the Careers Committee of the Institution gives every encouragement to the view that the Gas Industry at least is well aware of this need. The need extends, however, to a far wider sphere than in our own Industry. The President of the Institution of Chemical Engineers has pointed out that in America some 2,500 graduate chemical engineers are turned out each year and find ready employment in industry. In this country we are content to turn out less than 40 a year. There must be properly thought-out schemes for taking promising young men and women from school and training them for responsible technical and scientific posts in every industry. We were struck by Sir Ernest Simon's mention of an investigation conducted at Manchester University, using the methods of industrial applied psychology. It appears from that that only one-sixth of the best brains of the country find their way to the University. We are throwing away on second-rate work thousands upon thousands of clever young people every year—a waste of our manpower, an example of administrative inefficiency that must be stopped at the earliest possible moment.

It will be clear from what we have said that the problem of research must be looked upon from a much wider angle than that of laboratory experimentation. Research in itself is only a small part of what must be done in the application of science to industry. *Application* of knowledge is a major problem. The Federation's conference was primarily directed to research. Nevertheless we must not forget that although we have to

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apply scientific knowledge to industry to a far greater extent than we have done in the past in order to increase our industrial efficiency, one of the greatest necessities of every British industry, including the Gas Industry, is to develop new products. It is worth quoting here the words of Sir William Larke, who has pointed out that there is no need for self-depreciation, and that in fact our habit of self-depreciation is leading us almost into defeatism. "It is well to remember," he said, "what British industry has achieved in the last 200 years, and the benefits which it has conferred on the social and material life of mankind, as a result of the fact that this country was the birthplace of the fundamental discoveries of such men as Dalton, Priestley, Davy, Faraday, Watt, Rutherford, and Thompson, these discoveries being translated by British industries into the provision of the amenities and services of our daily life. A similar revolution is in progress to-day. Never before in the history of mankind has there been such a flowering of the tree of human knowledge as in the present century, and particularly in this country in the last 10 years. The results of the application of that knowledge are even yet immeasurable: for example, in the production of new materials; in medicine; in the internal combustion engine; in aeronautics and in the release of atomic energy, to name only a few of the outstanding groups."

Where does the Gas Industry stand in all this? First, it may be noted that one of the tendencies of the application of science to industry is to increase the size of the individual unit. Only large units can undertake research and development work on a large scale. Quite often the small unit finds itself unable to apply research because it has in operation expensive plant which has not been sufficiently amortized to be scrapped. The future development of the Gas Industry into much larger units than most of those existing to-day appears to be an inevitable by-product of the application of science.

REVITALIZATION

THE Gas Industry is in a sense a microcosm of British industry in that it is an old industry needing to be revitalized. It can only be revitalized by research and by the application of science. New products are required. We are not at all sure that these new products will be anything like those that we are producing to-day. It is quite possible that the work of the Gas Research Board may lead to an increase in the chemicals manufactured from coal, so that, in addition to supplying fuel, we shall also supply chemicals in the form of intermediates to the chemical industry proper. Nor must it be forgotten that the Gas Industry is the servant of all industries, as we have pointed out already. This means that a great part of our research, a great deal of our effort towards new developments, must be in the application of gas and coke to industrial purposes. By so doing we shall serve the best interests of the nation. The report of the Fuel and Power Advisory Council has presented the Gas Industry with a great opportunity in providing gas and coke for the greater part of the domestic usage of the country. An opportunity for expansion has arisen, in the course of which it will be possible to do many things that could not be done with the present works. This expansion will lead to new works, and may well lead to a complete rebuilding of the gas production plant of the country. It cannot be denied that the Gas Industry is now handicapped by its age. So many works have been built piecemeal, little by little over half a century or more, that they are very much in need of complete scrapping and rebuilding on a comprehensive plan in order to reduce manufacturing costs. The opportunity for this may very well arise with the new order that seems likely to come, and particularly with the expansion that the adoption of the report of the Fuel and Power Advisory Council would bring about.

There is an outstanding need for men in every gas undertaking, large and small, who have been trained to understand scientific work and to apply it. This is true not only of the Gas Industry, but of every firm in the country in every branch of industry. It may be asked whether we are yet undertaking sufficient research. That is a question which needs more careful examination than can be given here. But a pertinent commentary on the difference between our methods and those of America may well be that at the annual luncheon of the Institution of Chemical Engineers we conversed with a young man who told us that he was the head of a research laboratory of an American oil company—not one of the largest companies—and that there were under him 750 research men. How many research men does the Gas Research Board employ?

Personal

Mr. R. B. SMITH, Works Superintendent of the Hamilton Gas Department, has been appointed Resident Engineer to the Northwich Gas Company.

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Mr. T. P. REAY, London Area Sales Manager of Cannon Iron Foundries, Ltd., who recently underwent a serious operation, is making favourable progress, and hopes to be well enough to resume his contacts in the course of a few weeks.

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Mr. BERNARD P. BEZANT has joined the Board of Walter King, Ltd., Proprietors and Publishers of the "GAS JOURNAL," to fill the vacancy caused by the death of Mr. W. Rupert King. Mr. Bezant is Superintendent of the Tonbridge and Sevenoaks Works of the South Suburban Gas Company. His father, the late Mr. Arthur Bezant, was for many years Editor of the "JOURNAL" and a Director of Walter King, Ltd.

Obituary

Walter T. Dunn

The death occurred at Hastings on April 16 of Mr. WALTER T. DUNN, who retired from the Secretaryship of the Institution of Gas Engineers in 1928 after 32 years' service. He was appointed in 1896 to succeed Mr. F. G. Burfield as Secretary of the Incorporated Gas Institute, and when amalgamation with the old Institution of Gas Engineers took place in 1902 he was selected as Secretary of the new body, and carried out the duties of that office continuously from the Statutory meeting until he left for a holiday in August, 1928. Before entering the Gas Industry Mr. Dunn had had considerable experience of technical associations, for he was in the offices of the Institution of Mechanical Engineers for about eight years prior to 1894, when he surrendered his post there to devote the whole of his time to the Junior Institution of Engineers, of which he became Secretary. Two years later he went to the Institution of Gas Engineers, but he still carried on the Secretaryship of the Junior Engineers until he found it impossible to do justice to the increasing duties of the two offices. He had been trained as an engineer in the workshops of Maudslay, Sons, and Field, Ltd., and was one of their apprentices to receive a scholarship which enabled him to enter the evening class department of King's College, of which he took full advantage. On many occasions Mr. Dunn officially represented the Institution at meetings of kindred bodies at home and abroad, and although he retired from active work 18 years ago he still maintained a keen interest in the work of the Institution, of which he remained an Associate.

Mr. John Terrace, who was President of the Institution at the time of Mr. Dunn's retirement, writes: Walter T. Dunn's long and valuable services were much appreciated by the members throughout 32 years' service. His death recalls several landmarks in the history of the Institution which might with advantage be recorded here for the benefit of the younger members. The origin of the Institution was the British Association of Gas Managers, founded in 1863, and in 1882 the name was changed to "The Gas Institute." In February, 1891, owing to internal dissension the "Incorporated Institution of Gas Engineers" was formed, and during the next 12 years the Gas Industry had two technical institutions. Happily in 1903 an amalgamation took place, and since then the present Institution of Gas Engineers has become the channel of developments which have been of inestimable value to our Industry. In his long service with the Institution Mr. Dunn was always an enthusiast, and the initial work necessary and application for a Royal Charter obtained in 1929 was in great measure due to his pertinacity. He was made an Associate of the Institution in 1921.

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Mrs. Cloudesley Brereton

The death occurred at Norwich on April 16 of Mrs. M. A. CLOUDESLEY BRERETON, for many years a unique figure in the Gas Industry. When the British Commercial Gas Association was inaugurated in 1912 she became its first Editor and Consultant, and she filled the post with great distinction until her retirement in 1932. She was already well known not only in Great Britain, but on the Continent and in the United States in virtue of her own achievements. She had

been Principal and Bursar of the Homerton Training College for Teachers at Cambridge, and was a member of the Institute of Journalists, and later Vice-President of the Society of Women Journalists, a member of the Royal Sanitary Institute, a Fellow of the Institute of Hygiene and a member of the Royal Institute of Public Health. In all her varied activities she was a great success, and few people, even in the Gas Industry, realized the originality of the work she put into the advertising of gas.

Intensive Courses for Gas Engineers

It is officially announced that the Intensive Course in Gas Engineering at Bournemouth, under the Government's Further Education and Training Scheme, is now full, and there are no further vacancies.

A letter has been sent to enquirers concerning a similar course which is to be commenced on June 3, at the Birmingham Central Technical College.

S.B.G.I. Silver Medal Awards

The Council of the Society of British Gas Industries have again this year awarded Silver Medals to each of the Junior Gas Associations for the best Paper adjudged to have been presented during the year by their members at a general meeting. Twelve papers were submitted by six Junior Associations for adjudication. They were all of a high standard.

The awards are as follows:

London & Southern District Junior Gas Association.—A. E. Livett (Gas Light and Coke Company), for Paper on "Bread Baking."

Manchester & District Junior Gas Association.—Frederick Bell (Liverpool), for Paper on "A Gas Distribution System."

Midland Junior Gas Association.—J. A. Tomes (Stourbridge), for Paper on "The Use of Town Gas in the Processing of Glass Tableware."

Western Junior Gas Association.—R. W. N. Cameron (Bristol), for Paper on "Boiler Water Treatment."

Yorkshire Junior Gas Association.—A. Cole (Bradford), for Paper on "Two Fuel Industry."

Diary

April 25.—Women's Gas Council: Executive Committee, Gas Industry House, 1 p.m.

April 26.—Manchester District Association of Gas Engineers: Annual Meeting; Presidential Address, G. E. Currier.

April 26.—London and Southern District Junior Gas Association: "Power Plant and Machinery for Exhausting and Boosting of Gas," L. J. Clark, Gas Industry House, 7 p.m.

April 26.—Southern Association of Gas Engineers and Managers (Eastern District): "The Place of the Gas Industry in the National Fuel Economy," Dr. G. E. Foxwell, Gas Industry House, 2.30 p.m. (Committee Meeting, 11.15 a.m., Gas Industry House.)

April 27.—Manchester and District Junior Gas Association: Visit to Liverpool; Discussion on Report of the Gas Installations Committee (Ministry of Works Post-War Building Studies, No. 6), to be opened by R. J. Rogers, Chairman of the Committee.

April 27.—Scottish Junior Gas Association (Eastern District): Visit to a Colliery of the Fife Coal Co., Ltd.

April 30.—Institute of Fuel: Whole Day Conference on Waste Heat Recovery, Burlington House, Piccadilly.

May 1.—Federation of Gas Employers (Scottish Central Committee): 28th Annual General Meeting, Central Station Hotel, Glasgow, 2.30 p.m.

May 1.—Solid Smokeless Fuels Federation: Technical Committee, 2.30 p.m., Gas Industry House.

May 2.—Midland Junior Gas Association: Annual General Meeting, followed by an Address by a member of the Gas Research Board.

May 7.—Southern Association of Gas Engineers and Managers: General Meeting, Grosvenor House, Park Lane, 2.15 p.m. Discussion opened by Dr. E. W. Smith, "Regionalization and the Heyworth Report."

May 8.—North-Western Fuel Luncheon Club: "Fuels and Nationalization," Colonel W. A. Bristowe, Engineers' Club, Albert Square, Manchester, 12.30 for 12.45 p.m.

May 9–10.—Wales and Monmouthshire Association of Gas Engineers and Managers: Annual Meeting, Prestatyn. Presidential Address, O. P. Cronshaw.

May 10.—London and Counties Coke Association: Technical Committee, Gas Industry House, 2.30 p.m.

May 15.—Solid Smokeless Fuels Federation: Executive Committee, 11.30 a.m., Dorchester Hotel, Park Lane.

May 17.—London and Southern District Junior Gas Association: Annual Meeting, Gas Industry House, 7 p.m.

The Year's Coal Supplies

The Minister of Fuel and Power announces that the restrictions on supplies of coal and coalite to domestic and other premises controlled under the Coal Distribution Order during the 12 months beginning May 1 will be as follows:

Southern England (London, Eastern, South-Eastern, Southern, and South-Western Regions).—Maximum for 12 months is 34 cwt., of which not more than 15 cwt. may be supplied during the six months May–October.

Northern Regions (Midland, North Midland, North-Eastern, North-Western, Northern, Wales, and Scottish Regions).—Maximum for 12 months is 50 cwt., of which not more than 10 cwt. may be supplied each three months, May–July, and August–October.

Although the annual totals are the same as during the present year, there is no guarantee that they will be met in full, and Mr. Shinwell emphasizes that any supplies distributed during the summer months, except where coal is the only means of cooking, should be put into stock for use next winter, and that there should be no consumption for any other purpose than cooking during May to October.

Coke, anthracite, Welsh dry steam coal, and manufactured fuels other than coalite are in a separate group, and may be obtained, supplies permitting, up to a total for the group of 40 cwt. during the 12 months in any region (not more than 20 cwt. in each six months).

Yorkshire Juniors

The March gathering of the Yorkshire Junior Gas Association took the form, on April 16, of a visit to the works of Yorkshire Tar Distillers, Ltd., at Stourton, Leeds, when a party of between 70 and 80 members, led by the President (Mr. C. A. Newham, of Leeds Corporation Gas Department), was welcomed by Mr. J. B. Vickers, Managing Director, and Mr. W. A. Bell, Works Manager.

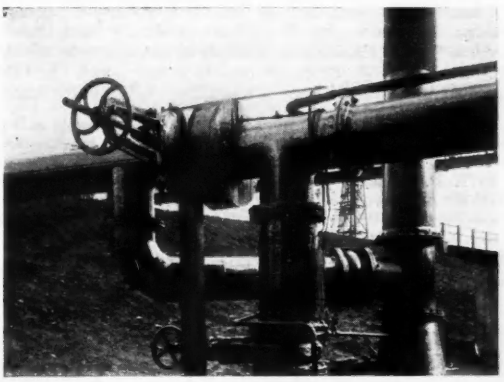
The visitors were shown the Wilton continuous tar distillation plant, the cresol hydrogenation plant, and various other installations associated with the chemical refining processes at the Stourton Works.

After tea Mr. Newham voiced the thanks of the party for the facilities granted and the firm's hospitality, and Mr. Bell suitably responded.

After Five Years

An interesting repair was carried out about five years ago on a 24-in. main from the ovens to the gasholder at the works of a North of England coke oven plant. On the day in question the gas had been shut off while repairs were being carried out below the valve. The main above the valve had, of course, the full pressure from the coke ovens.

The job was practically completed when, on tightening the valve flange to that on the repaired main, the valve itself cracked on the



live side opposite and the gas rushed out. There had been too much stress and strain on it to hold. This serious situation was overcome by donning gas masks and wrapping the valve with Denso tape, there being no other means of shutting off the gas. A wooden box was then built round it and liquid cement poured in. It still holds after five years, and the Denso still seals the leakage, as the cement only gives the mechanical strength to hold the Denso in place.

The Spring Golf Competition of the North British Association of Gas Managers was held over the Sandyhills Course, Glasgow, on April 11, and the following were the prizewinners:—Handicap: 1, D. Munro (Glasgow), 87 − 7 = 80; 2, S. Hall (Edinburgh), 88 − 8 = 80; 3, W. Kirk (Motherwell), 94 − 13 = 81; 4, D. D. Burns (Glasgow), 85 − 3 = 82. Visitors' Handicap: 1, D. Hamilton (Glasgow), 92 − 14 78; = 2, L. Fletcher (Glasgow), 86 − 6 = 80.

Important Gas Light Appointments

Four Group Engineers

The Gas Light and Coke Company announces important changes in the Chief Engineer's Department to help in the modernization programme on which millions of pounds are to be spent in the next four to five years. Four Group Engineers have been appointed to take charge of groups of stations, and in future each Station Engineer will be responsible to one of the four newly-appointed officials who, in turn, will be responsible to the Chief Engineer at Westminster.

The aim is decentralization of a kind similar to that which led, just before the war, to the setting up of the Divisional Organization, with Divisional Managers responsible for co-ordinating sales and service in their own particular sections of the Company's area, which has proved a great success. By having to deal with only four groups instead of 12 individual stations Mr. N. Willsmer, who became Chief Engineer on the appointment of Mr. F. M. Birks as Managing Director a few months ago, will be relieved of a great deal of routine and detail work which now takes up much of his time. In addition he will be able to draw more readily on the combined experience of four senior Engineers.

Bearing in mind that Beckton has about 100 times the production capacity of Staines, the new organization gives a more balanced picture of the Company's resources. During the war years a minimum of repairs and replacements has been carried out, and some of the works suffered severe damage from enemy bombing. Rehabilitation and renewal of plant and ancillary machinery would normally be regarded as a 10-year programme, but it is hoped to carry it out in about half that time. The new appointments are as follows:

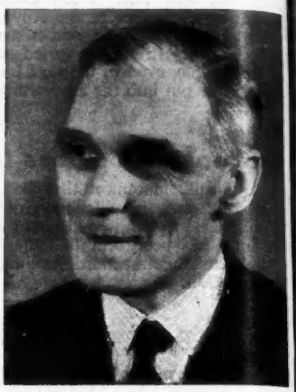
Group 1 (Beckton and Southend): Dr. J. Burns, formerly Station Engineer at Stratford, and previously Acting Deputy Station Engineer at Bromley.

Group 2 (Bromley, Bow Common, Stratford, and Shoreditch): Mr. S. T. P. Perry, for nearly nine years Station Engineer at Bromley, after 18 years as Station Engineer at Brentford.

Group 3 (Fulham, Nine Elms, and Kensal Green): Mr. S. Hay, for 32 years at Beckton—since 1941 as Station Engineer.

Group 4 (Southall, Brentford, Harrow, and Staines): Mr. E. G. Stewart, Station Engineer at Fulham since 1941, and formerly Assistant Chief Engineer.

Consequent upon these new appointments there have been some changes in Station Engineers and Deputy Station Engineers. In Group 1, Mr. H. Bradley (Deputy Station Engineer at Fulham since 1941) takes Mr. Hay's place as Station Engineer at Beckton, with Mr. G. Dougill (Chief Assistant Engineer at Beckton since 1941) as Deputy Station Engineer. In Group 2, Mr. H. W. Moys (Deputy Station Engineer at Bromley since 1943) succeeds Mr. Perry as Station Engineer at Bromley, with Mr. B. W. Dawkins (Assistant Engineer at Stratford since 1941) as Deputy Station Engineer. Mr. W. J. R. Waterfield (Kensal Green) becomes Deputy Station Engineer at Stratford. In Group 3, Dr. A. E. Haffner (an Engineer at Nine Elms since 1940) becomes Station Engineer at Fulham in place of Mr. Stewart, with Mr. R. G. Plummer (Assistant Engineer at Fulham since 1941) as Deputy Station Engineer. Mr. J. A. Rose (Acting Deputy Station Engineer at Nine Elms for the past three years) becomes Deputy Station Engineer at Nine Elms. In Group 4, Mr. D. C. Bertram (for five years Deputy Station Engineer at Beckton) will become Station Engineer at Southall in succession to Mr. W. H. Warren, who is retiring shortly. Mr. S. H. W. Boyns (at Brentford since 1934, and formerly Assistant Engineer with the Harrow Gas Company when it was taken over in 1926) becomes Station Engineer at Brentford.



MR. N. WILLSMER, *Chief Engineer.*

DR. J. BURNS: (*Group* 1). *Joined the Gas Light & Coke Company as Research Chemist in* 1929. *B.Sc. and Ph.D. of Aberdeen University. Later Acting Deputy Station Engineer at Bromley. Just before his new appointment he was Station Engineer at Stratford.*

MR. S. T. P. PERRY: (*Group* 2). *Was with the Brentford Gas Company when amalgamation took place in* 1926. *Mr. Perry was Station Engineer at Brentford until* 1944, *when he went to Bromley in a similar position.*

MR. S. HAY: (*Group* 3). *Joined the Company as Pupil Engineer, later appointed Junior Assistant Engineer at Kensal Green. Transferred to Beckton in* 1914 *and appointed Station Engineer of that Works in* 1941.

MR. E. G. STEWART: (*Group* 4). *Joined the Company as Pupil Engineer; became Junior Assistant Engineer and later Senior Assistant Engineer at Fulham. Transferred to Ilford, then Westminster. Was for a time Assistant Chief Engineer before going in* 1941 *as Station Engineer, Fulham.*

North British Association of Gas Managers

THE Spring Meeting of the North British Association of Gas Managers was held on April 12, in Coatbridge Town Hall, the President, Mr. T. S. Lockhart (Rothesay), welcoming a large attendance. At the outset a civic welcome was accorded to the members by Provost John Pirie, M.B.E., Coatbridge, who said that the President had spent many pleasant years at Coatbridge, and they appreciated the fact that he was holding that meeting there. The Gas Industry was keeping abreast of the times, and he felt that soon it would become illegal to use raw coal unless in exceptional circumstances. If that came about it would clear areas like Coatbridge of a perpetual blanket of smoke. At Coatbridge, said the Provost, they had cheap gas, and as the surplus gas from Baird's Gartsherrie Works was taken by the Company, fuel was saved and there was no waste. Personally he was against nationalization of the Gas Industry, and he urged members to watch any developments carefully.

Returning thanks, the President said that whatever their views were on nationalization, the service of the community was their main concern.

Reference was made by the President to the deaths of Messrs. McGill (Slamannan), Robertson (Cardenden), Barker (Nairn), and Low (Elgin), all ordinary members, and of Messrs. T. W. Jardine (Manchester), and J. A. McLay (Glasgow), and it was intimated that Mr. McLay had bequeathed £100 to the Benevolent Fund of the Association.

Colonel C. M. Croft, President of the Institution, was unable to be present, and on his behalf Mr. J. Hunter Rioch (Cambridge), a Member of Council and President of the Eastern Association, conveyed good wishes for a successful meeting.

Presidential Address

Mr. **Lockhart** then delivered his Presidential Address, an abstract of which was published in the "JOURNAL" of April 17 (page 635).

Mr. **J. M. Dow** (Paisley), in proposing a vote of thanks to the President, said it was difficult to be optimistic during these difficult and unsettling times, when the Gas Industry had become the shuttlecock of party politics, and was in danger of being overloaded by "mass hysteria" before it had had time to recover its balance from those six devastating years of war. This address, written, as it had been, in the smooth waters of beautiful Rothesay Bay, where the pall of smoke from heavy industrial areas did not dare to venture, where the air was clear, and less befogged by intrigue and suspicion, would be helpful to all of them to survey the requirements of the future. The President had seen fit to come to that famous industrial town to express his views—not only on his own achievement at Rothesay, but on important aspects of national policy. They admired him for his strength of purpose, for his faith in the Industry, and for his outspoken criticism of the nation's fuel policy, which surely nationalization, if it was to do anything at all, must put right first of all. In his symposium they read but little more than a passing reference to the real trials that beset the Rothesay undertaking during the difficult war years. Yet behind that enchanting Rothesay smile was borne an anxiety which few were ever privileged to discover. Shut off as he was from the mainland for many long spells, with a greatly inflated demand created through the multiplicity of war duties thrust upon the Clyde Estuary, the practicability of maintaining the Burgh's gas supply must have presented an almost overwhelming task. Yet they never heard of failure or complaint. Surely such endeavour could not go unrecognized.

Mr. **H. S. Milne** (Aberdeen), in seconding, said Mr. Lockhart had indicated some of the special problems which confronted those responsible for an undertaking remote from the more industrialized parts of the country, problems enhanced by the dependence on sea transport for all supplies, both of coal and of general stores. That isolation called for careful anticipation of requirements, and constant watchfulness to ensure that stocks of materials and spares were fully adequate. He had stressed the need for a proper discrimination in the allocation and use of the country's diminishing coal resources. The Gas Industry had led the way in its appreciation of coal as a vital raw material rather than simply as a fuel, and although some headway had been made in enlightened circles, it had unfortunately required a world war to bring to the public notice the significance of fuel and of coal in particular.

In his reference to the modern gas fire Mr. Lockhart made special reference to ventilation. The question of ventilation was one to which reference could not too often be made, and it was satisfactory to note that in the recent Egerton report on the Heating and Ventilation of Dwellings it was recommended that flues should be provided in living rooms, kitchens, and in all bedrooms. There had been some suggestions lately that district heating might be used in housing schemes and that the houses would have no chimneys. If this meant that no flues would be provided, one would be inclined to have some doubt as to the standard of ventilation and comfort which would be obtained. Mr. Lockhart's address was an able survey of the work and problems of the Gas Industry. There was one matter, however, which had not been mentioned, namely, the serious shortage of adequately trained and experienced technical staff. This shortage would continue to get worse so long as there was uncertainty as to the period of military training which young men would have to undergo, and it might be that a solution to the problem would be found in the employment of men from outside the Industry who had already received a general technical training, and by so arranging their duties that they might within a reasonable time acquire experience in gas engineering.

The **President** briefly acknowledged the vote of thanks, and paid tribute to the help given him by the Secretary and the Council members.

Luncheon Speeches

Members were subsequently entertained to lunch by the Coatbridge Gas Company, Mr. Peter S. Murray, J.P., presiding and welcoming the guests.

The **Earl of Dumfries**, proposing the toast of the "North British Association," expressed satisfaction that Mr. Lockhart had been chosen as President. As Convener of the County and Laird of Bute he came into frequent contact with him, and was glad of the opportunity of doing something for one who had done so much for him and his people. Coatbridge had an unequalled war record, marred by no stoppages of any kind, and it was appropriate, therefore, that for their first post-war Spring Meeting they should gather there.

The Gas Industry did not know whether or not it would be taken over, but, in any case, it would continue to serve the public with unimpaired zeal, even though the public did not appreciate all that gas meant to them. Familiarity with it for 100 years had bred contempt, but the present coal situation was making the people realize what gas really did mean. It was surprising that the Gas Industry had carried on so well, and he hoped the new Coal Board would keep it adequately supplied. Coal was the breath of its life, and without it the Industry would sicken.

Replying, the **President** said that many years ago, when attending night classes in Coatbridge, he had hopes of becoming a gas manager, but he had never dreamed that some day he would have the honour and pleasure of being President of the North British Association. His Lordship had spoken of the change of control that was coming. He considered it certain that the Government would carry out its pre-arranged plans. Certain bodies were pressing for more local control, if nationalization came, but the North British Association was a purely technical body, meeting to discuss technical matters and interchange views. Their main concern was the welfare of the consumer, and they had no politics in the Association, merely wanting the best for the Industry they all loved and served. He himself would welcome any change, whether it was nationalization or anything else, provided those in authority at Whitehall saw to it that the salaries paid were sufficient to attract the best brains into the Industry. It needed the finest brains to solve the present fuel problems.

Proposing the toast of "The Guests," the **Chairman** said the Gas Industry had shown itself progressive and alive to modern needs. Whatever the future might bring, he hoped private initiative would be encouraged to provide cheap gas, one of the highways to national prosperity.

Replying, Sir **Patrick J. Dollan** said he greatly appreciated the work done by the Coatbridge Gas Company. He wished to thank the Gas Industry for the great help given during the war to the Ministry of Fuel and Power and to the people of Scotland. A new Efficiency Department was being started up by the Ministry of Fuel and Power, but if all the coal-consuming industries were as efficient as the Gas Industry it would not be needed, and they could save 4,000,000 tons of coal yearly. Their weekly production of coal was 100,000 tons less than in 1939, and so long as that difference remained they were not within sight of safety. But both increased efficiency and increased output were needed. They could not predict how the change in ownership would work out, but he personally did not wish to see the Industry in Scotland managed by six people, three part-time and three Government officials. The proposals must be amended to make available in the control of the Industry a greater share of the technical skill and knowledge that existed in Scotland.

Provost **Bonner** (Airdrie), said that some years ago the Coatbridge Gas Company was approached when Airdrie was in some difficulty regarding its undertaking. The ratepayers of Airdrie had decided to retain their own undertaking, but he wished to say that their representatives had received nothing but courtesy from the Coatbridge Gas Company.

Proposing the toast of the "Coatbridge Gas Company," Mr. **J. Hunter Rioch** (Cambridge) said the Directors had pursued a bold, realistic and successful policy, providing other undertakings with executive officers of a high order like Mr. Lockhart. In their area they had the great responsibility of supplying an adequate quantity of gas cheaply, their whole requirements being met from the coke ovens and blast furnaces at Gartsherrie. No less than 900,000,000 cu.ft. of gas were used annually, and he congratulated both the Gas Company and the Ironworks Company on the co-operation which had proved so beneficial to both and to the country. It was only through integration that cheap, efficient and adequate service could be assured; he did not use the word "nationalization." Larger units, with teams of specialists, were required, and integration should be based on sound economic and geographical lines.

Mr. **T. R. C. Hurll** replied, in the absence of ex-Provost James Tennent.

Production and Storage of Liquid Methane*

By Sir A. EGERTON, T. A. HALL, and M. PEARCE

[A "GAS JOURNAL" Abstract]

THE Paper under review is a continuation of "The Significance of Liquid Methane as a Fuel," presented to the Institute of Fuel by Sir Alfred Egerton and Mr. M. Pearce last year (*J. Inst. Fuel*, August, 1945), to which reference was made in an Editorial of the "GAS JOURNAL" in the issue of Sept. 12 of that year, p. 361. The following is a brief abstract of the two Papers taken together:—

The leading properties of methane are:

Boiling point		— 161.5°C.	
Critical temperature		— 82.15°C. (pressure 45.8 atm.).	
Calorific value (by weight),	gross	23,900 B.Th.U./lb.	at 60°F. and 30 in. Hg.
" "	net	21,520 "	
" (by volume),	gross	998 "	
" "	net	898 "	

One gallon of liquid methane is approximately equivalent to 100 cu.ft. of free gas; 1 ton of the liquid occupies about 500 gall. Density at boiling point is 0.43, so that 0.88 lb. of methane is equivalent in thermal value to 1 lb. of petrol, and 1.51 gall. of liquid methane is equivalent to 1 gall. of petrol (sp. gr. 0.74). What makes it attractive as a motor fuel are that its rel. c.v. is 14% greater than that of petrol, and its high octane value. The compression ratio can be so raised that converting a petrol vehicle to methane there is an increase of power, and at the same time the fuel consumption is improved by at least 20%.

Compared with compressed coal gas, methane having double the c.v. has double the range of action for the same capacity of cylinders, while liquid methane has the advantage over gaseous methane that a 27-gall. tank weighs one-sixth of the steel cylinders required to contain the gas at 3,000 lb./sq.in. Compared with petrol, a 27-gall. tank with evaporator and other equipment weighs 325 lb. against 164 lb. for a 16-gall. petrol tank with carburetter, &c.; the mileage on one charge is 144 for liquid methane against 128 for petrol, and the weight per mile of action is 2.26 lb. against 1.28 for petrol. Liquid methane comes nearer to petrol in this respect than either compressed coal gas or compressed methane. Taking advantage of the higher compression ratio at which methane can be used, it should be possible to obtain a mileage per gall. very little lower than that with petrol.

Evaporation Losses

"The disadvantages are all included in the fact that it has to be stored as a cold-boiling liquid, and there is therefore loss by evaporation." The trials carried out have been focused on overcoming this difficulty. Road trials reported in the 1945 Paper reached the stage of a 10,000 mile trial with a single-deck bus of the Lincolnshire Road Car Co. Liquid methane was not available throughout the whole period of running, but between April and October, 1944, out of an aggregate of 26,085 miles, 9,905 miles was run on this fuel. The average consumption was 5.2 m.p.g. on methane including 2½% night evaporation losses against 7.2 m.p.g. on petrol. Further examination of this figure in the second Paper showed that it was affected by the type of vehicle tank in use. With the tank finally selected as the most suitable, 7,200 miles was run at 5.5 m.p.g. on the same basis. It was considered, however, that the inclusion of losses during standing times in service would increase evaporation losses to 9%, giving a true net performance of 5.95 m.p.g. Allowing 3% filling loss reduced this to 5.35 m.p.g.

This trial was run with the standard compression ratio of 5.5 : 1. In the second trial this was raised to 8 : 1, but, while the increase of power was marked, the performance at 5.15 m.p.g. net (against 5.95) was disappointing. The explanation put forward is that the higher figure does not represent a fair comparison "owing to the economy enforced on the driver by the lack of power."

Storage

After trials of several alternatives the tank adopted for installation on the vehicle (described as 32 gall. vacuum-jacketed tank N1) was constructed of copper, cylindrical with convex dished ends, hard soldered, with an austenitic steel 3-in. diameter neck.

Evaporation losses increase as the tank empties. Practically no loss occurs when it is nearly full of liquid, since the time required for the absorption of sufficient heat to raise the pressure to that of blow-off is roughly proportional to the quantity of liquid, taking 14 hours to reach 15 lb./sq.in. and 22 hours to reach 30 lb. If therefore the vehicle tank is filled just after coming out of service at night, losses from night-standing are reduced to the minimum.

Problems arising in large-scale storage are studied in considerable detail. Storage above ground is dangerous, but underground should be comparatively safe. Conditions of low temperature limit the choice of structural materials to copper and its alloys, alloy steels, and aluminium and some of its alloys. Further experimental work is required to arrive at a decision among these alternatives. The favoured system of lagging is a metallic outer casing "either hermetically sealed or breathing through a drying agent," the space between it and the tank itself being filled with granular insulating material and then evacuated of air. The economically practicable limit of size of such a tank is perhaps 25,000 gall.

It is probable that with a combination of big tanks near the liquefaction plant and tank cars for the supply of motor vehicles, loss by evaporation in storing and filling would be something like 12%. With methane at 10d. per gall., plus 1.2d. for evaporation and 0.5d. for equipment and a compression rate 8 : 1, the equivalent price of petrol would be 14.0d.

Safety

Methane is ignitable between the limits 5.3% and 14.9% methane in a mixture with air, against 1.5 to 5.5% petrol, "in a 3-in. tube with vertical propagation." Methane is "not ignited under any circumstances with an ignition source lower than 700°C., whereas petrol vapour can be ignited by sources at temperatures between 200 and 300°C. under certain circumstances." Methane is thus less easily ignited than petrol vapour. A methane flame is very easily extinguished and, as its density is less than one-sixth that of petrol vapour and about half that of air, it rises and escapes by roof ventilation without danger.

Sources

"So far as this country is concerned the main source of methane would have to be the carbonization products of coal. The extraction of methane from town gas could only be an adjunct to the activities of the Gas Industry," but it is suggested that it might be possible to convert most of the coal direct to methane, liquefied and stored, "thereby eliminating the impurities in gas, removing its poisonous constituent, CO." More practically, it is suggested that the gas-works should extract and store methane as liquid during the summer and re-evaporate it in the winter, using it then as an enricher, to equalize the load on the carbonizing plant. The case of a London works making 75 million therms per annum at 530 B.Th.U./cu.ft. is studied in detail. A flow sheet (or diagrammatic plant lay-out) is given for the separation of ethylene and methane from coal gas. Such a system would be equally applicable to coke-oven gas.

Applications and Advantages

The advantages of the proposals put forward in these Papers are claimed to be, *inter alia*, that "calorific value" can be stored as liquid methane in a small space (two underground tanks, 25 ft. by 20 ft. by 10 ft., would be more than equivalent to a 10-million gasholder), enrichment by liquid methane would replace the use of imported oil, and the complete removal of sulphur, water, and CO_2 would accompany the extraction of methane. Liquid methane would not only be applied to the internal combustion engine, but could also be used as fuel readily transportable to sparsely populated districts now served by the smallest gas undertakings or not at all.

There remain a number of problems to be solved before these proposals could be carried out on a large scale, but "the study of the significance of liquid methane has led to a ramification of investigations in many directions, and has resulted in providing much of the information which would be needed if any of the schemes involving its use were to be launched."

Stockton-on-Tees Corporation has applied to the Ministry of Fuel and Power for sanction to spend £5,896 on the supply of gas to about 500 houses to be built by the adjoining Thornaby Corporation. Specifications are to be prepared for additions to the carbonizing plant at Stockton.

An Attractive Programme has been arranged for the annual general meeting of the Eastern Association of Gas Engineers and Managers to be held at Cambridge on May 21–23. The business meeting will be held at the Dorothy Restaurant on the morning of May 22. The annual golf competition will be played over the course of the Gog, Magog Club on the afternoon of May 21, and there will also be a bowls match on the Cambridge University and Town Gas Light Company's green, followed by a reception in the evening. Luncheon on May 22 at the invitation of the Gas Company will be followed by a tour of the Colleges in the afternoon and the Association dance in the evening, and on May 23 there will be an inspection of the gas-works and the Association luncheon.

* Presented to the Midland Section of the Institute of Fuel, Feb. 27, 1946.

A New Method of Increasing Retort Tightness*

By A. G. BIRD, M.I.Mech.E., M.Inst.Gas E.

THE successful layout, construction, bringing into operation and subsequent maintenance of the carbonizing plant is of major importance to a gas undertaking. It still remains true that upon the continued efficiency within the retort house—the first step in gas manufacture—the success of the undertaking depends. This efficiency is closely bound up with the features of the setting design, but it is equally dependent upon the stability of the structure of the retorts or chambers themselves, and particularly upon their initial and continued gas-tightness. The interplay of expansion stresses in the refractory materials during the drying-out period, and later on when the setting is brought up to carbonizing temperatures, makes a perfectly gas-tight construction difficult to attain.

Great strides have been made during the past 15 years, based upon research and experience both in the quality of refractories, in the arrangement of expansion allowances within the brickwork of the settings, and in the design of the retort bench bracing. The bench bracing particularly has been arranged with provision for adjustment to accommodate the expansion of the refractories which occurs in the initial stages of operation and in the period of restarting after repairs. In all this development the necessity of keeping sufficient force upon the retort structure to assist gas-tightness has been recognized, while making allowance for the inevitable expansion resulting from rise of temperature (fig. 1). The success of these provisions has been considerably advanced in consequence of the building of retorts in refractory shapes of small dimensions. This, however, has brought into prominence the problems associated with the characteristics of the jointing cement.

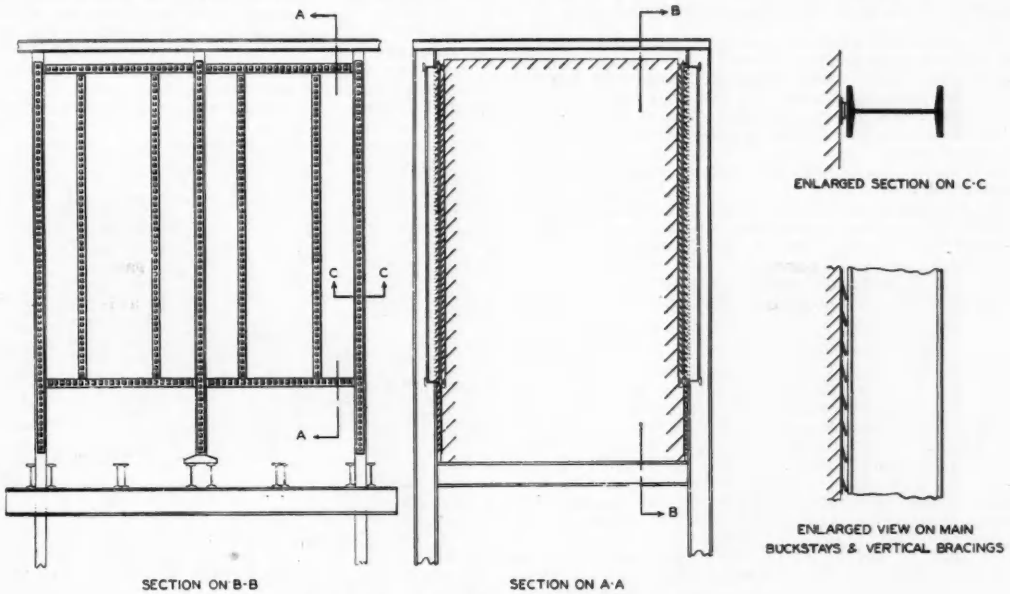


FIG. 1.—*Retort bench bracing with expansion plates.*

Jointing material for furnace and retort construction is required to respond to demands which are sometimes contradictory. It must be refractory; it must not flux the material of the refractory bricks or shapes, and yet it must vitrify sufficiently to form a strong physical bond. It must be sufficiently fluid to be workable, but must not shrink on drying or firing. These exacting requirements make it almost impossible to prepare a jointing compound which fully meets every demand upon it.

In the coal carbonizing industries silica and siliceous refractories are generally used, and such refractories undergo considerable thermal expansion before the temperature of the retorts and settings is high enough to vitrify the jointing material. This mitigates against the possibility of each and every brick or shape in the structure maintaining complete contact on all its surfaces with the adjacent pieces. It is generally accepted that the thinner the joints, the less likelihood there is of leakage through the jointing material. Thin joints demand high "workability," which, in turn, largely depends upon water content. Research has shown that the water content of the jointing material must be carefully controlled in the preparation of retort cements. Some progress has been made in the determination of the optimum water content for a wide range of jointing materials, and valuable information on this subject is now available[1].

Even after every precaution has been taken almost every newly constructed retort or chamber reveals some degree of leakage when it is heated up and prior to being put into operation. If the construction is well designed and has been carefully executed, these leakages are of small dimensions. The filling of such cracks and crevices has generally been left until their size necessitates some effort being made to stop them up. All retort house operators are familiar with the laborious attempts made with spraying, plugging, hot-patching and many other methods of filling up holes in retorts whilst at carbonizing temperature.

Though the new process to be described herein is available for immediate application to new retorts, it is not suggested that it should be applied to retorts that have developed definite holes or cracks of considerable dimensions. It is, therefore, desirable to review the investigations made into this subject.

In a Paper by H. Pardoe[2] the advantages of gas-tightness in carbonizing plant were emphasized. It was pointed out that in the case of gas retorts, a slight leakage will materially reduce the thermal yield and will have a deleterious effect upon the various residuals, and where the pressure within the retorts exceeds that of the combustion chambers the control of the heating is affected. Leakage is also liable to give rise to local overheating of the retort under reducing conditions—a combination of circumstances likely to damage the refractory material of which the retort is built.

Pardoe discussed the subject of patching from two standpoints: (*a*) an effective method of application and (*b*) the selection of the refractory cement of which the patch is to be composed. At the time of his survey the available methods of application were four in number —*viz.*, spraying, paddle patching, air guns and detonator guns. His experience had shown that spraying definitely prolonged retort life by preventing excessive erosion. Howevcr, spraying in this sense is not classified as hot-patching. Pardoe stated that, in the belief that spraying offered a solution of leakage troubles, he had experimented with white-washing machines and had achieved a fair measure of success. Considerable mechanical difficulty, however, was experienced principally because the tube and nozzle fouled in the hot zones. Experiments with a spraying machine with air pressure in combination helped to prevent fouling, and as the velocity of the charge was thereby greatly increased, much more even and effective work was done.

Turning to the next method of patching—*i.e.*, paddle patching—Pardoe emphasized that the manipulation of even a 16 ft. paddle is extremely difficult. Regarding air guns, two types were found to give good service, particularly when operated at as high a pressure as 30 to 35 lb. per sq. in., but a heavy air gun could not be operated accurately over long distances in a vertical retort. The other type,

* Paper presented to the Southern Association of Gas Engineers and Managers (Eastern District), March 26.

the detonator gun, was found to be more accurate, and two or three shots of cement could be placed per minute if great skill and patience were exercised by the operator.

Dealing with the complex subject of refractory cements suitable for hot-patching, it has, of course, been recognized, as with the problem of ordinary jointing cements, that the requirements are conflicting. Thus, high refractoriness is required, yet the cement must have some fusible constituent so that it will adhere to the walls. Again, the cement must have cohesion, yet the introduction of much clay will cause it to exhibit a firing contraction and will also necessitate the presence of a considerable amount of water—a particularly undesirable feature in hot-patching work. Pardoe, in the Paper already referred to, stated that after much experimental work he had found the following mixture generally applicable to hot-patching with paddles, air pressure apparatus and guns:—

Fine silica sand (200 mesh)	3 parts.
Pre-calcined bauxite grog (10 mesh)	2 "
Powdered glass (100 mesh)	3%
Powdered vegetable glue	2%
Lime	1.5%

Still further, the presence of glass was found to give effective adhesion on contact and to hold the cement in position. The glass is fluid at about 1,150°C., but the mixture as a whole has a refractoriness of about 1,550°C. This mixture was useful both for application with a paddle and with a gun.

The Refractory Materials Committee of the Institution of Gas Engineers, in 1930, delegated a further investigation on hot-patching cements to the British Refractories Research Association. A review[3] of the problem suggested that a successful hot-patching cement for retort work should conform to the following conditions:

(*a*) Should be sufficiently refractory for the temperature at which it is to be applied, and yet should vitrify enough to enable it to resist such abrasive action as may be caused by the charging or discharging of machinery, or in the case of vertical retorts, by the downward movement of the charge.

(*b*) Should not become brittle, powdery or non-plastic until well into position.

(*c*) Should not disrupt while the water or other plasticizer is being eliminated.

(*d*) Should not interact unduly with adjacent retort material.

(*e*) Should give a slight permanent expansion at the normal working temperature, or at least show a minimum of permanent contraction on prolonged exposure to these temperatures.

(*f*) The particle size of the cement had considerable bearing on its suitability for the various classes of patching work undertaken.

The laboratory specification cannot meet all the requirements of the various conditions under which patching is to be undertaken, so that no single cement can be universally applicable. On the basis of the experimental work carried out, it was deduced that hot-patching cements should contain as much grog as possible, and it was found that such highly grogged mixtures can be plasticized by the addition of cellulose liquor. Powdered glass was again suggested as being useful in giving the patch a good high-temperature bond.

According to E. Comblés[4], refractory cements for patching coke ovens should have a softening point of at least 150°–200°C. above the working temperature of the oven; other properties sought in such cement are low porosity, high spalling resistance and good adherence. The latter demands a similar thermal expansion in the cement and the brickwork. According to this German report, the required conditions are fulfilled by a correctly proportioned mixture of quartzite sand, clay and sodium silicate.

Further work on hot-patching was published[5] by the British Refractories Research Association in 1932. At the outset, attention was directed to the essential property which, for convenience, may be termed "stickability." A finely ground silica cement containing about 12% of clay was used as a basis for this work, and organic bonding materials were added. The usefulness of sulphite lye as an addition to hot-patching cements was quickly proved, but the results also emphasized that a satisfactory jointing cement cannot be transformed into a good hot-patching cement merely by the addition of sufficient sulphite lye. It was evident that the usefulness of the organic addition was limited to the few seconds during the actual application; a further "mid-temperature" bond is required. Accordingly it was sought to develop requisite properties in the cement by two expedients. Firstly, in an endeavour to mitigate the effect of the sudden volatilization of water from the cement, a proportion of crude glycerol was added to the water used in preparing the mix. It was hoped that this would improve the working properties by extending the time during which the cement dried in position. But the intended result was not achieved, and a really permanent adhesion of the hot-patch was still not obtained. Secondly, various fluxes were added to the cement, most of them having a melting-point below 1,000°C. Again the results were unpromising and recourse was had to a different technique, namely, the application of dry cements with a gun or blow-pipe.

The application of wet cement spraying, spray welding and trowelling methods for hot-patching coke oven walls have been described by S. Tweedy[7].

A great step forward was made when the blow-pipe spray welding technique was introduced by T. F. E. Rhead, S. K. Hawthorn and V. H. Deacon[6], using dry cements. This process was and still is applied with great success in making up comparatively large holes in retort walls without the necessity of cooling down.

A. H. Clucas[8] suggests a useful expression for leakage in the following form:

Leakage index = Leakage in cubic feet (at 60°F.) per hour for every one-hundredth inch W.G. pressure exerted within the retort.

The leakage index represents the condition of the complete retort, including the mouthpieces and joints between these and the retort sections, and a continuous record of this figure assists in keeping check of the life of the retorts.

The Problem

The foregoing survey indicates steps which have been taken to increase the life of retorts; there still remains the problem, which exists in all carbonizing plant, of producing a retort or chamber which is gas-tight before carbonization begins and maintains such tightness throughout its normal life, or inversely of reducing to the minimum the leakage which is practically unavoidable in new retorts. This latter problem is interconnected with the maintenance of durability.

Observations have been made on newly constructed vertical retorts heated to 1,050–1,100°C., and a high leakage has been recorded which can only be explained by the presence of very many fine cracks in the joints and brickwork at that temperature, and possibly a leakage around the retort fittings. Some of these leakages may disappear as the temperature rises, but during the working life of the bench stresses are set up not only within the retort structure itself, but arising out of the possible growth of the refractories of the setting, which produce movements in the retort structure after the jointing material has become integrated with the refractory structure. Sometimes the strength of the refractory piece is less than that of a joint that has slagged, in which case the refractories themselves may crack. But

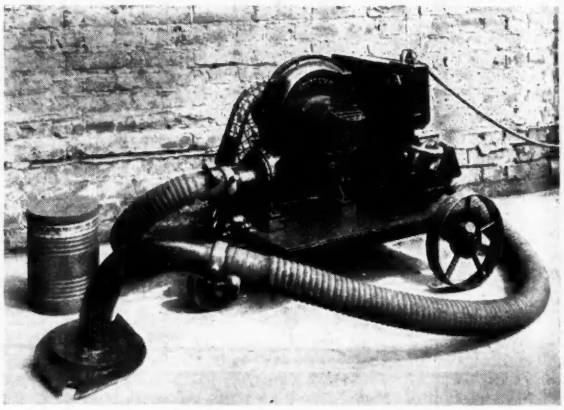


FIG. 2 —*Airborne sealing unit with electrically driven fan.*

more serious are the disturbances set up when the settings are let down during periods of low load or for incidental repairs, when the whole structure contracts and the monolith of the retort is disturbed. It is not an uncommon practice to take the opportunity, while retorts are cold, to point up all loose joints. This may cause additional stress and movement when the settings are again heated up.

Two methods of securing gas-tightness suggest themselves: (*a*) to form a glaze on the surface, and (*b*) to reduce the porosity of the refractory brick and joints to a negligible value. The glazing of some portions of the retort surface takes place naturally. Fluxes present in the coal react with the complex of the refractory material to form compounds of comparatively low melting-point. But it is impossible to control the glazing of the whole surface of the retort, particularly vertical retorts, in this manner, and uncontrolled surface fusion may lead to a complete breakdown.

Graphite acts as a sealing agent, but scurf—as it is known in connexion with gas-works practice—is not formed over the full length of the vertical retort. Attempts have been made to force gases, carbon or ash particles into the interstices of the retort construction by working at a higher than normal pressure within the retort after scurfing, but this method is not to be recommended in view of the established fact that such penetrations have a detrimental effect upon the life of the retort.

It was decided to investigate the possibility of depositing in the smallest crack and crevice of the retort wall minute particles of a suitable refractory which should adhere to and become part of the retort structure itself. The idea was not new[9]. It was, as a matter

of fact, on record 40 years ago, but no one had solved the two problems, first to devise apparatus convenient and above all handy enough to be readily used on the retort bench and, secondly, to devise and prepare a refractory cement pulverized to the correct degree of fineness to be air-borne and capable of remaining in contact with the retort structure under working conditions. Experimental work, started in this direction some years ago, was encouraged by some success in obtaining tighter gas retorts. But this tightness was not permanent, although it did allow time for retorts to be sealed by the ingress of the ash particles given off in the carbonizing process.

During the war period maintenance and the necessity for tightening up retort walls assumed a greatly increased importance. The demand for resetting complete units to overcome the failure of a small length of each retort must be avoided in order to conserve refractory material. We all know some 60% of good material is wasted when faulty zones in retorts have to be renewed. The work of repairing hot retorts *in situ* was, therefore, further intensified. During the past three years apparatus (fig. 2) for carrying out the airborne sealing process has been in practical operation on a considerable number of installations.

The Method

Airborne sealing is a method of maintaining the condition of retorts and keeping them gas-tight by filling up, rather than sealing over, the fine cracks and pin-holes. The sealing material is a specially prepared and pulverized refractory powder, which is carried in suspension in an air stream and blown into the closed and empty hot retort or chamber before it is charged, and periodically after each scurfing. A differential pressure between the retort and the setting combustion chambers is maintained, so that the particles of sealing powder attempt to follow through with the escaping air stream and are entrapped in the crevices or joints, tending to build up these joints until the resistance of the retort to leakage is restored. The particle size and method of application which allows flotation of the powder also tends to fill over the rough surfaces and recesses.

The jointing powder is manufactured with a scale of particle size between that which allows flotation in the air stream—*i.e.*, will pass through 100 mesh, and a proportion so small as to pass through 200 mesh. Experience has shown there is considerable advantage in this grading of particle size to allow the "herding" of such particles as they are "caught-up" in the cracks and crevices and on the roughened portions of the retort surface itself. The object is to build up a deposit with as few voids as possible.

Early work showed that to mix a pulverized silica flour with added clay particles and a fluxing agent in a dry state was not successful, because the particles of the different components separated on flotation. A more elaborate manufacturing process was therefore decided upon, using as a base a pulverized flour of the type of silica of which the retort and jointing material were formed. This flour was put in suspension in water, to which the required amount of clay and flux was added, and by milling for a prolonged period it was thought that each and every particle would become an individual sealing unit. A special manufacturing plant had to be built to dry and repulverize the compound, as it was considered necessary that at no stage should any temperature during the production process be above that of the first expansion of the silica. Immediately on putting the new type of sealing powder into practice, surprising results were obtained.

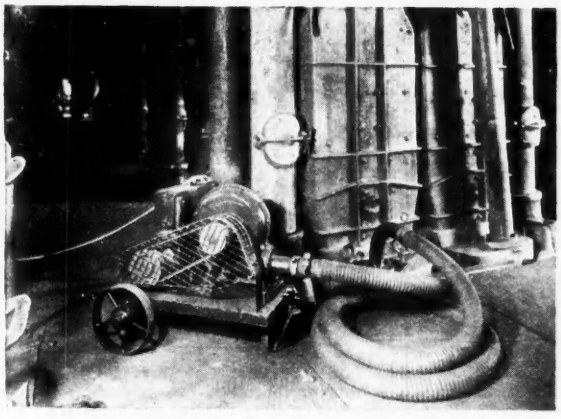


FIG. 3.—*Airborne sealing unit in position.*

In the application of the sealing powder, another important point is that only very small increments should be passed into the air stream at a time so as to form a "mist." The supply of powder to, say a vertical retort of 50 in. major axis 25 ft. long is maintained at the rate of approximately 1 oz. per minute, and generally application for 20 minutes is sufficient, the time being limited by the necessity to maintain the temperature of the retort. If further application is required, the retort should be allowed to regain a suitable surface temperature by ceasing air-blowing and closing the retort for an hour or so.

On the other hand, it was found that if the powder is blown into the retort too rapidly there is a tendency for only a skin sealing of the very fine cracks to take place, whereas the object is to avoid the powder being arrested until it is as deep as possible within the crevice or crack.

The above is, in brief, the principle of the airborne sealing process; the practical details are as follows:

The air is supplied by a petrol or electric motor-driven fan, which is designed to give at zero outlet pressure 300 cu.ft. per minute. More important is the fact that the fan is also designed to refuse to give a higher pressure on the outlet than 12 in. water gauge. This airborne

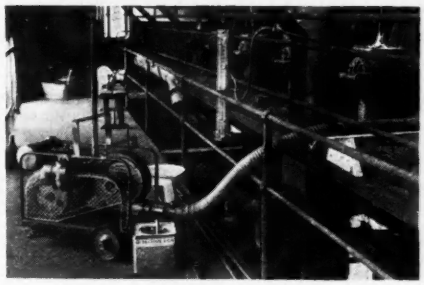


FIG. 4.—*Airborne sealing unit (petrol-driven) in position.*

sealing unit may be fitted with a motor suitable for the current available, or an internal combustion engine fuelled either with petrol or gas (see Appendix 1). A suitable carburettor for operation with coal gas direct from the mains is described in Appendix 2. Such a carburettor may be found useful for other works purposes.

The powder for airborne sealing is measured and fed by hand through a small adjustable chute attached to the impeller air intake. Adjustments to this chute enable the quantity of air supplied to the fan to be controlled, which in turn affects the pressure within the retort. The sealing powder is carried in suspension by the air stream

FIG. 5.—*Operator feeding sealing powder to fan inlet.*

through a 3 in. flexible hose, at the end of which is applied—in the case of continuous vertical retorts—a small dummy mouthpiece, and for other retorts some method of allowing the powder-laden air to have access to the retort interior. A small butterfly valve is placed immediately at the retort inlet in any case, so that when the fan is stopped, the hot air from the retort will not return through the hose.

As already referred to, before the airborne sealing process is carried out the retort must first be completely scurfed. After scurfing, the temperature of the retort face should be maintained as high as possible, and definitely above 1,050°C.

Next, the retort fittings—*i.e.*, the mouthpiece, etc.—at both ends must be made airtight, and attention must be paid to the joint between the brickwork of the setting and the mouthpiece. Any leakage at these places, however, is instantly revealed by the escape of the powder as soon as airborne sealing commences, and should receive attention before the process continues. It is advisable not to allow pressure within the retort to exceed, say, as a practical limit, 6 in. water gauge, but for new retorts the air intake is regulated so that by observation

on the water gauge about 2 in. pressure within the retort is obtained, and as the sealing powder is applied, it will be found the quantity of air required to maintain this pressure must be reduced. If the original opening of the air intake shutter is noted before sealing commences and put back to the same position after sealing, an increase in internal pressure within the retort will be observed. In one particular instance where the process is regularly applied, 6 in. internal pressure within the retort under these conditions has been accepted as showing that the retort is sealed and is ready to be put into operation, but normally 2 in. to 3 in. indicates a tight retort.

Although good results have been obtained in the sealing of fairly large openings, it cannot be expected that the sealing powder will fill up cracks more than, say, $\frac{1}{8}$ in. wide. It is, however, believed that if the sealing process is applied when the retorts are new, and if, subsequently, retorts for the first year of their life are sealed at each time of scurfing and afterwards possibly every three or six months, deterioration of the retort will be appreciably retarded until such time as complete resetting becomes necessary.

It is as well to point out at this stage that for satisfactory repair work on silica or siliceous retorts the pulverized refractory compound is itself of a highly siliceous nature, and comes within the scope of those clauses in the Factory and Workmen's Compensation Act, which deal with silicosis. The men during the manufacture wear masks as approved by the Home Office, the reference being Mark IV, Home Office Approved Type Respirator, obtainable from Messrs. Siebe, Gorman & Co., Ltd., Davis Road, Tolworth, Surrey, and it is suggested that operators should also take a similar precaution.

An approximate analysis of the powder is—

SiO_2	80%–85%.
Al_2O_3	2.0–6.5.
Fe_2O_3	Not more than 0.4.
CaO	2.0–7.5.
Alkali	2.5–4.0.
Loss in ignition	2.0–4.5.

The particle sizes are approximately:

Through 100 mesh	50%.
,, 150 ,,	30%.
,, 200 ,,	20%.

The process has been in use on many carbonizing plants over the past twelve months, and some data has been collected in Appendix 1. Working instructions issued with the machines are reproduced in Appendixes 2 and 3.

Conclusion

The writer would like to express his thanks to Mr. C. T. Price, of Hampton Court, who allowed the first experimental trial. Also to Mr. H. Wilkinson and his assistant, Mr. Owen, at Slough, who during 1942 placed several Glover-West continuous vertical retorts at his disposal for experimental purposes; and to your Association for the opportunity of putting forward for more general use a process which has been found useful in connexion with continuous vertical retorts.

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(7) TWEEDY, S.—Patching Cements (for Coke-Oven Walls), *Gas World*, 1943, **118** Coking Section, p. 3).

(8) Publication No. 81, Inst. Gas E.—"Report on Leakage in Horizontal Retorts."

(9) Kopper's U.S.A. Patent Specification No. 18,159/1901.

Appendix 1.—Works Reports

WORKS "A."—Several months ago tests were made on four retorts to ascertain the effects of scurf formation on the inert content of the coal gas immediately after scurfing. The method was that immediately all four retorts had been filled and turned into the main a sample of gas was taken and analysed for inert content. Subsequent samples were taken at several hours' interval until it was found that the inerts had fallen to a steady percentage. At various periods during the 28 working days samples were again taken, which confirmed that once a consistent figure had been reached (usually about 36 hours after turning in) it remained constant until the retort was again scurfed.

The gas samples were taken from a continuous representative stream over a period of not less than one hour.

Following the treatment of the same four retorts on the 16th instant similar tests were made on the gas and below are the comparative figures:

	Untreated retorts.			Retorts airborne sealed.		
Hours on line	...	12	36	...	18	36
% CO_2	4.4	4.0	3.2	1.6	1.9	2.2
O_2	0.0	0.0	0.0	0.0	0.0	0.0
N_2	10.5	8.4	4.4	4.3	3.9	5.0
Total inerts	14.9	12.4	7.6	5.9	5.8	7.2

The above are corrected to oxygen free basis. The results are graphed in fig. 6.

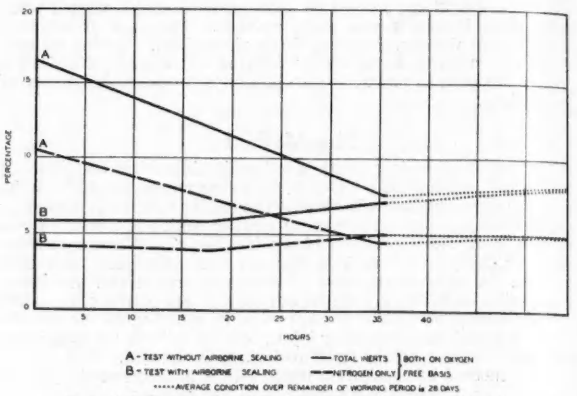


FIG. 6.—*Graphs showing observations at Works "A."*

Previous tests show that during the normal 28-day working period the total inerts average 8.3% and nitrogen 5.0%.

WORKS "B."—Retorts are treated after each "scurfing." Pressure is set to 2 in. W.G., and treatment continued until it reaches 6 in. W.G. in an average period of 1½ hours. Average quantity of powder used per retort is 10 lb. Allowing half an hour for setting up and dismantling apparatus to each retort, the average cost per retort is:

	s.	d.
Operator, 2 hours at 2s. 2d.	4	4
Powder, 10 lb.	5	0
Petrol, ¼ gallon		8
Oil		3
	10	3

WORKS "C."—Similar to "B" except that no additional labour is employed, the operation being carried out by the "Heats" Attendant. 5 lb. powder per retort costing 2s. 6d. is sufficient. Allowing 4d. for power (electricity) the cost is 2s. 10d. per retort.

WORKS "D."—The following are typical results:

Retort No.	Period treated.	Compound used.	Commencing pressure.	Final pressure.
2	2 hours	3½ lb.	3 4/16 in. W.G.	7 4/16 in. W.G.
4	2 ,,	3½ ,,	1 6/16 ,,	6 9/16 ,,
6	2 ,,	3½ ,,	1 3/16 ,,	7 ,,
8	2 ,,	3½ ,,	2 ,,	6 9/16 ,,
1	2 ,,	3½ ,,	2 4/16 ,,	6 5/16 ,,
3	2 ,,	3½ ,,	2 6/16 ,,	7 5/16 ,,
5	2 ,,	3½ ,,	2 3/16 ,,	6 3/16 ,,
7	2 ,,	3 ,,	3 ,,	7 ,,

WORKS "E."—A number of vertical retorts, which had been put into operation in the autumn of 1945, and were going through their second scurfing cycle, were treated. The resistance to leakage was considerably improved after an average of 1¼ hours' treatment Pressure rose steady from 1½ in. W.G. to 4 in., which was the maximum obtainable in this type of retorts owing to the water-sealing of the bottom doors.

WORKS "F."—A bench of Westvertical Chambers had been rebuilt in Scandinavia silica. Owing to difficulties with the jointing material preliminary filling of the larger leaks by welding was necessary. Airborne sealing was then applied for a minimum of 4 hours to each chamber, and in one or two instances for as long as 8 hours. With one exception a final pressure of 6 in. was obtained with constant air volume. The durability of this work is not definitely established, but operators will persevere with the process.

WORKS "G."—Five retorts have been treated with the machine, with the following results:

No. 64 Retort, No. 6 Bench.—This retort had four small leaks in the bottom fireclay formed shortly after the bench was put to work.

The operator demonstrated the apparatus on this retort, and the first application was not very successful, but a second application was more promising, although not completely successful, three out of the four leaks being sealed. The operator gave his opinion that the temperature of the retort at the zone of the leaks was not high enough.

Nos. 11 *and* 12 *Retorts, No.* 1 *Bench.*—These two retorts had been bad for some time, and we had been repeatedly welding the leaks each scurfing period. No. 11 had four leaks in the silica work, and No. 12 five leaks in silica and one in bottom fireclay.

The treatment was successful on these retorts, pressure was maintained for 2½ hours afterwards and no sign of leaks appeared.

Nos. 67 *and* 68 *Retorts, No.* 6 *Bench.*—A further trial was made on No. 6 Bench, where most of the retorts have had small leaks in the bottom fireclay.

No. 67 retort had one leak and No. 68 had four. The process appeared to be effective on these retorts except in one case, where the crack was considerably reduced in size.

First impressions of air-borne sealing are that it is far in advance of our present method, the main advantages being:

(*a*) The apparatus is simple and easy to operate.

(*b*) The working conditions for the men using the plant are much better in every way than with the other processes.

(*c*) Less time is required to complete the work, and retorts are brought into service earlier.

(*d*) The operations do not interfere with the routine working of the plant.

(*e*) No dismantling of bottom cover plates, etc., is necessary, as in the case of welding.

(*f*) The process will be more economical than the present method.

(*g*) Small unsuspected and inaccessible leaks will most probably be sealed.

(*h*) Due to the simplicity of the apparatus, it could be used as a general routine on all retorts after scurfing, and would no doubt prevent leaks developing.

Appendix 2.—Airborne Retort Sealing

Airborne sealing is a method of maintaining the condition of retorts and keeping them gastight by sealing up fine cracks and pinholes.

A specially-prepared finely-ground refractory powder, carried in suspension in an air stream, is blown into a closed hot retort after scurfing, the air being supplied through a suitable fan. This refractory powder is borne by the air passing through any fine cracks and pinholes, and is progressively deposited in them until they are completely made up. The repair is stabilized by the action of heat on the retort walls.

Figs. 7 and 8 show portable units driven respectively by an electric motor and a petrol engine equipped for operation at choice on coal gas, either unit being of about 3 h.p. Air is supplied from a 10-in. Davidson "Sirocco" (or similar) fan, with a suitable impeller to carry the sealing powder. This powder is fed by hand through a small shoot attached to the air intake. A shutter fitted to the intake enables the pressure of air in the retort to be regulated, the fan running at constant speed. The sealing powder is carried in suspension by the air through a 3-in. flexible hose and an injector bend which is mounted upon the retort charging door. A blank charging door is incorporated with the bend. A butterfly valve in the bend is provided to restrict up-draught from the retort when the fan is stopped, pre-

BRITISH PATENT No. 568,159

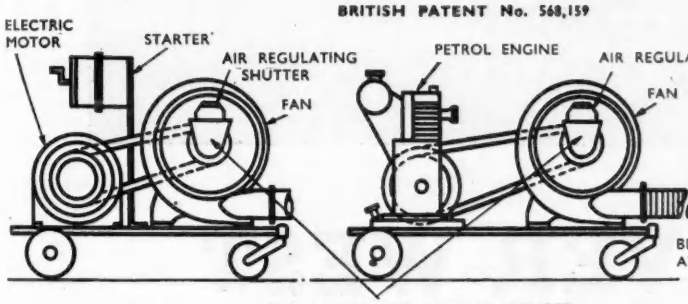


FIG. 7.

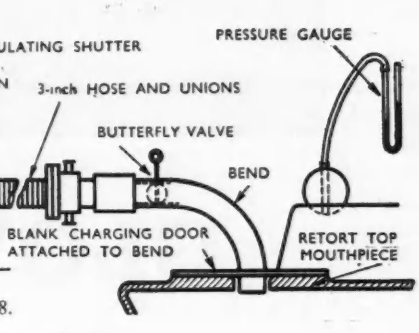


FIG. 8.

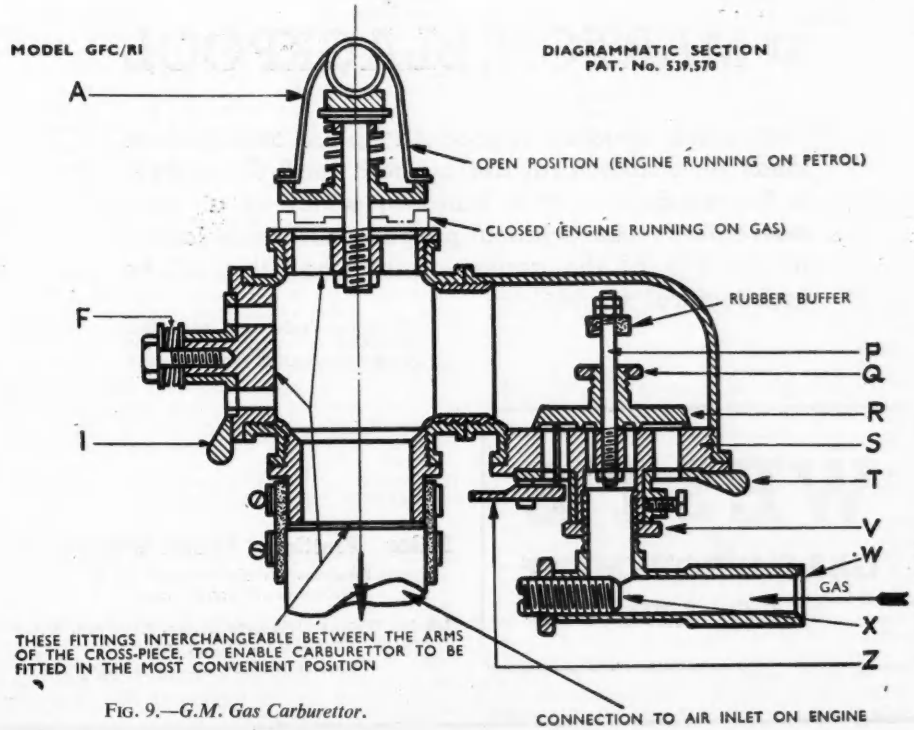
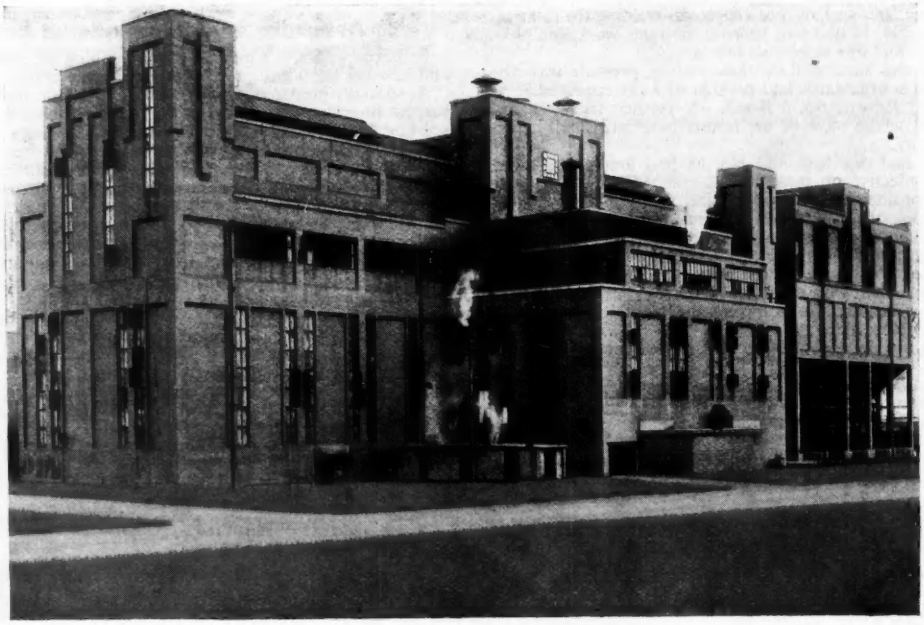


FIG. 9.—*G.M. Gas Carburettor.*



GLOVER-WEST

Vertical Retorts

at MARTON, BLACKPOOL

"Fortunately modern carbonising plant and modern ideas of architectural design both lend themselves to the production of a building which is at once convenient to its technical purpose and finds favour in the eye of the general public and that of the architectural world."

COMMUNICATION No. 230—PROCEEDINGS OF THE INSTITUTION OF GAS ENGINEERS 1939-40, p. 455

WEST'S
GAS IMPROVEMENT CO., LTD.

Miles Platting, MANCHESTER 10
Telephone: Collyhurst 2961-2-3-4-5.
Telegrams: Stoker, Manchester.

London Office: Columbia House, Aldwych, W.C.2
Telephone: Holborn 4108-9.
Telegrams: WESGASCO, ESTRAND.

venting damage to the hose and fan. Pressure in the retort is observed by means of a gauge connected to a ball hole or other convenient point on the retort mouthpiece.

Sealing powders are coloured for identification and are supplied in two grades—*viz.*, S 2 (blue) for normal use after scurfing, and S 4 (red) for special cases, for example for old retorts which are in a fairly bad condition.

It is important to keep the sealing powder dry, and only to use the powder recommended for this work.

The sealing powder supplied must not be used for other purposes.

Having regard to the provisions of the Factory and Workmen's Compensation Acts with respect to the danger of silicosis, it is recommended that men using the sealing powder should wear masks. The mask should be the Mark IV Home Office Approved Type Respirator, obtainable from Mesrs. Siebe, Gorman & Co., Ltd., Davis Road, Tolworth, Surrey.

WORKING INSTRUCTIONS

(1) The retort must be completely scurfed before sealing.

(2) The retort must be maintained at normal carbonizing temperatures. The interior of the retort should not be below 1,050°C.

(3) The retort must be made completely airtight at the top and bottom by sealing the fittings. Special attention must be paid to the joint between the brickwork of the setting and the top mouthpiece, which must be grouted in if necessary.

(4) The injector bend on the dummy charging door must be sealed in position with clay and a pressure gauge fitted.

(5) Start the fan and adjust the pressure in the retort by means of the shutter to between 1-in. and 2-in. W.G.

(*Note.*—The pressure in the retort must never exceed 6 in. W.G.)

(6) When the initial pressure has been obtained powder must be fed at an even speed into the retort in frequent and regular quantities. This is continued until the sealing up of any fine cracks and pinholes causes an appreciable increase of the air pressure in the retort above its initial value. About twice the initial pressure should always be aimed for, but is sometimes not attainable.

(7) Quantities of sealing powder required vary according to the condition of the retorts, but average between 7 and 14 lb. of powder in an average sealing time of 1½ to 2 hours. The tins supplied contain 28 lb. of powder.

Appendix 3.—G.M. Gas Carburettor

This carburettor, (fig. 9), as used on West's airborne retort sealing units, is designed to operate on coal gas direct from the mains, at town pressure. The gas supply pipe should be ½ in. diameter, minimum.

Gas enters through the pipe (W) which is controlled by a screw-in adjuster (X) and passes through ports to the underside of the mixing valve (R). Air enters to the underside of the mixing valve through controlled ports in the block (S). Additional air is admitted through the adjustable valve (F) to compensate for slight differences in mains pressure. A safety valve (A) is fitted for the event of a backfire, and this can be hooked up off its seat (as shown) to form an air inlet when the engine is to be run on petrol. A "tickler" (Z) is fitted to lift the mixing valve off its seat to "flood" the carburettor.

The carburettor is fitted direct on to the air intake to the petrol carburettor, by means of a short length of rubber hose and Jubilee clips. It is essential that the mixing valve spindle (P) should be vertical. It is generally necessary to provide some sort of support for the gas carburettor, to prevent its overhanging weight damaging the petrol carburettor. The additional air inlet can be moved to any of the arms of the cross to enable the easiest fitting of the carburettor. The gas inlet can be moved round by slackening the nut (V).

The weight of the mixing valve should just be sufficient to overcome mains pressure. If it is not, ½-in. washers can be placed under the nut (Q) until there is just no leak of gas under the valve. The valve face must be kept clean of grit and dust, otherwise there will be a permanent leak.

The main air ports in the block (S) should be about half open, and the additional air ports initially about quarter open.

The engine should be started, without using the choke, and the carburettor finally adjusted by means of the air regulator (I) and the gas regulator (X) until the best positions are found. Tighten up all locknuts.

Periodically the mixing valve assembly should be removed and washed in petrol. The valve spindle should NOT be oiled.—*Abridged from particulars supplied by G.M. Carburettor Co.*

Hinckley Gas Department is to apply for permission to borrow £2,500 to cover the cost of gas mains on the sites of permanent and temporary houses which are being erected.

A **New Battery of Coke-Ovens** and liquefaction plant to cost £220,000 is to be put down at Evenwood (Co. Durham) by Messrs. Sadle & Co., of Middlesbrough. The ovens will be of the latest design and will deal with 300–350 tons of coal daily. The plant will also make plastics, which will be supplied to firms making plastic articles.

Gas Undertakings' Results

Australian Gas Light Company.—Net profit for 1945, including the balance of £59,130 brought forward, amounted to £398,002. Interim dividend of 3% paid in August absorbed £145,800, leaving a balance of £252,202 to the credit of profit and loss appropriation account. A final dividend of 3% on the "A" and "B" shares leaves £106,402 to be carried forward. Gas sales yielded £2,719,090, as against £1,316,429 spent on manufacture and £513,883 on distribution.

Maryborough Gas and Coke Company (Queensland).—Sales of gas and by-products in 1945 showed a considerable increase over 1944, and there was also an increase in expenditure. The demand for gas refrigerators, stoves, coppers, and bath heaters was far in excess of supplies. Profit, after writing off £800 for depreciation, and transferring £400 to reserve fund, amounted to £3,330. A dividend of 5% leaves a carry-forward of £423, against £155 brought in. As the balance-sheet is now issued to shareholders annually instead of half-yearly, interim dividends are to be discontinued.

Shirebrook and District Gas Company.—A final dividend of 7½%, making 10% for the year 1945, has been declared, leaving £7,667 to be carried forward against £7,056 brought in. The balance carried to profit and loss account from revenue account was £8,925, out of which £5,333 has been provided for taxation. The Directors report that sales of gas increased and all consumers' requirements were met, although at times very severe difficulties prevailed.

Dividends

Wellington (Salop) Gas Company.—At the annual meeting it was resolved that a final dividend for the year ended Dec. 31 of 3½%, actual, less tax, on the Ordinary stock, be declared and paid, making, with the interim dividend already paid, a dividend of 7% for the year.

Sales Managers' Examination

For the first time in 19 years the Incorporated Sales Managers' Association will conduct its annual examination in six 2½-hour sessions over a period of three days—June 27, 28 and 29. The new time-table has been adopted to enable candidates to do full justice to their papers, and is the result of suggestions by representatives of technical institutes.

The final examination consists of six subjects: market research, marketing, budgetary control and sales forecasting, principles and practice of salesmanship, sales organization and control, and advertising. Information regarding these examinations can be obtained from the Association, 23, Bedford Square, London, W.C. 1.

Need for Chemical Engineers

The need for more trained chemical engineers to help secure the increased efficiency of production, which, he said, was essential if this country was to hold her own in the coming years, was emphasized on April 12 by Sir John Anderson, when speaking at the annual luncheon of the Institution of Chemical Engineers at the Connaught Rooms, London.

The President, Mr. Hugh Griffiths, said that in the United States something like 2,500 graduates were enrolled in chemical engineering every year, as against about 40 in this country.

Progress at Rochdale

Rochdale Corporation has received loan sanction for the reconstruction and extension of carbonizing plant, installation of waste heat boilers, a producer-gas fired boiler, new boiler house, retort house, coke screening plant, and coal and coke handling plants. The total estimated cost of the reconstruction, &c., will be about £300,000.

The carbonizing plant is of 2½ million cu.ft. per day capacity, and the coke screening plant will have bunkers for 600 tons of screened coke. The Corporation is advertising for tenders for a new spiral guided gasholder of 1½ million cu.ft. capacity.

The Coal, Iron, and Steel Industries are the subject of a series of industrial maps recently compiled by the Ministry of Town and Country Planning. The information contained in them refers to the year 1940, and was supplied by the Ministry of Fuel and Power and the Ministry of Supply. They are scaled at 10 miles to the inch, and the squares follow the lines of the National Grid. Coal and iron are dealt with in two sheets, which together embrace England and Scotland. They show exposed and concealed coalfields, iron-ore deposits, and many relevant details. The two sheets pertaining to iron and steel show weekly area capacities in tons for blast and open-hearth furnaces, Bessemer converters, coke ovens, &c., Smaller inset maps of Sheffield, Swansea, Scunthorpe, Middlesbrough, and Glasgow areas are incorporated. The maps may be obtained from E. Stanford & Co., Ltd., 12, Long Acre, W.C. 2, price 5s. each.